
UNIVERSITI PUTRA MALAYSIA

# DIETARY ENERGY AND PROTEIN REQUIREMENTS OF LESSER MOUSE DEER (TRAGULUS JA VANICUS) IN CAPTIVITY

DARLIS

IB 2001 1

# DIETARY ENERGY AND PROTEIN REQUIREMENTS OF LESSER MOUSE DEER (*TRAGULUS JAVANICUS*) IN CAPTIVITY

By

DARLIS

**Thesis Submitted in Fulfilment on the Requirement for the Degree of Doctor of Philosophy in the Institute of Bioscience Universiti Putra Malaysia**

**November 2001**

Abstract of the thesis submitted to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

**DIETARY ENERGY AND PROTEIN REQUIREMENTS OF LESSER MOUSE DEER (*TRAGULUS JAVANICUS*) IN CAPTIVITY**

By

**D A R L I S**

**November 2001**

**Chairman : Associate Professor Dr. Norhani Abdullah**
**Faculty : Institute of Bioscience**

A series of experiments was conducted to study various aspects of nutrition of lesser mouse deer to determine their dietary energy and protein requirements for maintenance and growth in captivity. When given a choice of feeds male mouse deer preferred sweet potato, while the female preferred carrot in terms of fresh weight. However, in terms of dry matter (DM) intake, the rabbit pellet (90% DM) was consumed the most by both male and female mouse deer. The daily intakes of DM, organic matter (OM) and gross energy (GE) were significantly ($P<0.05$) higher in male than female when given these feeds, but the DM intake was similar when they were fed only rabbit pellet. The crude protein (CP) intake was similar between male and female mouse deer when fed various types of feed or only pellet. The ability of male and female mouse deer to digest DM, OM and GE of feed were also similar.

In the energy expenditure and activity study, it was observed that both male and female mouse deer spent most of their time sitting (926.0 min/d), followed by standing (491.5 min/d) and eating (22.5 min/d). Heat production (HP) for male and

female (0.44 and 0.43 kJ/kg $W^{0.75}$/min, respectively) was the highest during eating followed by standing (0.37 and 0.33 kJ/kg $W^{0.75}$/min, respectively) and sitting (0.26 and 0.26 kJ/kg $W^{0.75}$/min, respectively). The HP for morning to afternoon and afternoon to evening periods were significantly higher than the night and early morning periods. The overall HP of males during morning to afternoon and afternoon to evening periods was significantly ($P<0.05$) higher than that of females.

When the mouse deer were fed diets containing 5% to 20% of fiber, the digestibility values of DM, OM, CP and GE were significantly ($P<0.05$) decreased with an increase in fiber level. Positive nitrogen balance and body weight gain was obtained when the levels of fiber were in the range of 5% – 10%. The passage rate constants of solid and fluid were significantly increased when more than 10% fiber was in the diet. On the other hand, the mean retention time of solid and fluid decreased with increasing levels of fiber in the diet.

Metabolisable energy requirements for maintenance in growing and mature mouse deer were in the range of 418.0 kJ/kg $W^{0.75}$/d – 424.9 kJ/kg $W^{0.75}$/d. Efficiency of utilisation of energy requirement for maintenance was 0.52 for growing mouse deer and 0.44 for mature mouse deer. Maximum nitrogen balance was achieved at 20% metabolisable energy above maintenance. The protein requirement for maintenance of growing male, mature male and mature female was 0.33, 0.25 and 0.28 g N/kg $W^{0.75}$/d or 6.4%, 5.4% and 5.3% CP in the diet, respectively and for growth was 0.93, 0.94 and 0.98 g N/kg $W^{0.75}$/d or 18.2%, 18.8% and 18.7% CP in the diet, respectively.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan ijazah Doktor Falsafah

**KEPERLUAN TENAGA DAN PROTEIN PELANDUK DALAM PELIHARAAN**

**Oleh**

**D A R L I S**

**November 2001**

**Pengerusi : Profesor Madya Dr. Norhani Abdullah**
**Fakulti : Institut Biosains**

Satu siri eksperimen telah dijalankan untuk mengkaji berbagai aspek pemakanan pelanduk untuk menentukan keperluan tenaga dan protein keperluan hidup asas dan tumbesaran dalam peliharaan. Apabila pelanduk diberi berbagai jenis makanan segar, pelanduk jantan lebih suka ubi kentang sedangkan pelanduk betina lebih suka lobak merah, tetapi dalam bentuk bahan kering (BK), pelanduk jantan dan betina lebih banyak memakan pelet arnab (90% BK). Pengambilan harian BK, bahan organik (BO) dan tenaga (T) pelanduk jantan lebih dari pelanduk betina bila diberi berbagai jenis makanan, tetapi bila hanya diberi pelet arnab, jumlah pengambilan BK pelanduk jantan adalah sama dengan pelanduk betina. Pengambilan protein kasar (PK) pelanduk jantan dan betina adalah sama bila diberi berbagai jenis makanan atau diberi pelet sahaja. Penghadaman BK, BO dan T pelanduk jantan dan pelanduk betina adalah sama.

Dalam kajian aktiviti dan penggunaan tenaga, pelanduk jantan dan betina menghabiskan masa untuk duduk selama 926 min/hari, diikuti dengan berdiri selama

491min/hari dan makan selama 22.5 min/hari. Penghasilan haba pelanduk jantan dan betina adalah paling tinggi semasa makan (0.44 dan 0.43 kJ/kg $W^{0.75}$/min), diikuti semasa berdiri (0.37 dan 0.33 kJ/kg $W^{0.75}$/min) dan duduk (0.26 and 0.26 kJ/kg $W^{0.75}$/min). Penghasilan haba dari pagi hingga tengahari dan dari tengahari hingga petang adalah lebih tinggi dari malam hingga awal pagi. Penghasilan haba secara keseluruhan pelanduk jantan dari pagi hingga tengahari dan dari tengahari hingga petang adalah lebih tinggi daripada pelanduk betina.

Apabila diberi makanan yang mengandungi 5% - 20% serat kasar, nilai penghadaman BK, BO, PK dan T menurun dengan meningkatnya kandungan serat kasar. Keseimbangan nitrogen dan pertambahan berat badan adalah positif bila kandungan serat kasar dalam lingkungan 5% - 10%. Pengaliran butir-butir kecil digesta dan cecair rumen lebih cepat apabila kandungan serat kasar melebihi 10%. Waktu retensi butir-butir kecil digesta dan cecair rumen menurun dengan meningkatnya kandungan serat kasar.

Keperluan asas tenaga metabolik pelanduk yang membesar dan dewasa adalah 418.0 – 424.9 kJ/kg $W^{0.75}$/hari. Kecekapan penggunaan tenaga untuk keperluan asas adalah 0.52 bagi pelanduk yang membesar dan 0.44 bagi pelanduk dewasa. Keseimbangan nitrogen yang maksimum diperolehi bila tenaga metabolik makanan melebihi 20% keperluan asas. Keperluan asas protein untuk pelanduk yang sedang membesar, jantan dewasa dan betina adalah 0.33, 0.25 and 0.28 g N/kg $W^{0.75}$/hari atau 6.4%, 5.4% dan 5.3% PK makanan dan untuk pertumbuhan adalah 0.93, 0.94 and 0.98 g N/kg $W^{0.75}$/hari atau 18.2%, 18.8% and 18.7% PK makanan.

## ACKNOWLEDMENTS

I wish to express my sincere appreciation and gratitude to Assoc. Prof. Dr. Norhani Abdullah, chairman of the supervisory committee for her invaluable guidance and untiring assistance throughout the period of my studies. Sincere thanks are also due to Professor. Dr. Ho Yin Wan and Assoc. Prof. Dr. Liang Juan Boo for serving as members of the supervisory committee and for their invaluable advice, suggestion and comments during the course of my work and in the preparation of the thesis.

I would like to thank the Malaysian government for the financial assistance given to me during my study in UPM, the University of Jambi for granting permission for leave of absence to undertake this study, Institute of Bioscience and the Department of Animal Science, Faculty of Agriculture, Universiti Putra Malaysia for providing the research facilities.

I am also grateful to Professor Tan Sri Dr. Syed Jalaludin Syed Salim for his invaluable advice and encouragement, Professor Dr. Dahlan Ismail for allowing me to use a few of his mouse deer, Dr. Bagus Purwanto of the Animal Science Department, Institut Pertanian Bogor, Indonesia for his advice and suggestions in the energy expenditure study and the Department of Wildlife and National Parks of

Malaysia (PERHILITAN) for approval to maintain the mouse deer colony at Universiti Putra Malaysia.

Sincere appreciation is extended to all my colleagues and staff of Digestive Microbiology Laboratory, Latiffah Zakaria, Kalavathy Ramasamy, Lan Gan Qiu, Sieo Chin Chin, Thongsuk Jetana, Vickneswary Dharmadas, Wan Zuhainis, Sideig Adam Abdalla, Khairul Kamar Bakri, Madam Haw Ah Kam, Jivanathan Arumugam, Nagaya Muniandy and Paimon Lugiman for their cooperation and assistance. Sincere appreciation is also extended to all the staff in the Nutrition Laboratory, Ibrahim Mohsin, Bakari Abd. Rahman and Saparin Denim, for their help.

Finally, I would like to express my sincere gratitude and affection to my loving wife Dra. Mardiani for her love, prayers, patience and encouragement throughout the duration of my study and, above all, to Almighty Allah S.W.T., for blessings on me and my family.

I certify that an Examination Committee met on 16th November 2001 to conduct the final examination of Darlis on his Doctor of Philosophy thesis entitled "Dietary Energy and Protein Requirements of Lesser Mouse Deer (*Tragulus javanicus*) in Captivity" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

**ABDUL RAZAK ALIMON, Ph.D.**
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

**NORHANI ABDULLAH, Ph.D.**
Associate Professor
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
(Member)

**HO YIN WAN, Ph.D.**
Professor
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
(Member)

**LIANG JUAN BOO, Ph.D.**
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

**RYOJI ONODERA, Ph.D.**
Professor
Division of Animal Science
Faculty of Agriculture
Miyazaki University
Japan
(Independent Examiner)

**MOHD. GHAZALI MOHAYIDIN, Ph.D.**
Professor/Deputy Dean of Graduate School
Universiti Putra Malaysia

Date : 23 NOV 2001

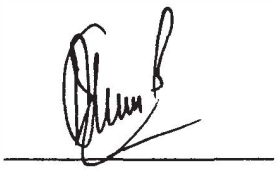
This thesis submitted to the Senate of Universiti Putra Malaysia has been accepted as fulfilment of the requirements for the degree of Doctor of Philosophy.

**AINI IDERIS, Ph.D.**
Professor/Dean of Graduate School
Universiti Putra Malaysia

Date : 10 JAN 2002

## DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.



DARLIS

Date : 23 November 2001

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

# CHAPTER 1

# INTRODUCTION

The lesser mouse deer (*Tragulus javanicus*) is widely distributed throughout the primary and secondary forests of Southeast Asian countries such as Myanmar, Thailand, Kampuchea, Vietnam, Malaysia, Indonesia and the Philippines. It is considered to be one of the most primitive ungulates still in existence (Morat and Nordin, 1978; Kay *et al*., 1980; Medway, 1983).

Medway (1983) reported that there are two species of mouse deer in Malaysia, namely, the lesser mouse deer (*Tragulus javanicus*) weighing about 1.2 – 1.8 kg and the larger mouse deer (*Tragulus napu*), weighing about 4 – 6 kg. Besides the two species, a number of subspecies such as *Tragulus javanicus pumilus* and *Tragulus javanicus klossi* are also recognized.

The mouse deer is considered a ruminant. However, its stomach consists of only three compartments: the rumen, reticulum and abomasum. Hofmann and Stewards (1972) classified the ruminant into three groups based on their feeding behaviour, i.e. concentrate selector, bulk and roughage eaters and intermediate feeder. The mouse deer can be classified as a concentrate selector (Kay *et al*., 1980; Agungpriyono *et al*., 1992). In its natural habitat, the mouse deer feed on